

1           Attorney Docket No. NA-1238

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3           LOW COST PARACHUTE

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5           STATEMENT OF GOVERNMENT INTEREST

6           The invention described herein may be manufactured and used  
7           by the U.S. Government for Governmental purposes without the  
8           payment of any royalty thereon.

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10           BACKGROUND OF THE INVENTION

11           1. Field of the Invention

12           The invention described and shown herein relates to  
13           parachutes and is directed more particularly to a low cost cargo  
14           parachute for use in providing water, food and supplies to areas  
15           unreachable by other means, for humanitarian relief, or for remote  
16           military operations.

17           2. Description of the Prior Art

18           In use, very few airdrop parachutes are returned for reuse.  
19           By and large, only in training does reuse of parachutes occur.  
20           Yet, parachutes are relatively expensive items.

21           Most cargo parachutes are round with numerous suspension  
22           lines attached to a skirt portion of the parachute fabric. A  
23           multitude of lines are sewn into the fabric to reinforce the  
24           fabric which itself is sewn together in pieces. A typical 26 foot  
25           high velocity cargo parachute is provided with 26 suspension

lines. Much of the expense incurred in the manufacture of such parachutes is devoted to the many feet of lines used and the sewing together of small pieces of cloth and reinforcement tapes. Typically a parachute of this type must be vented so as to survive high opening forces at altitudes of 25,000 feet, or more. Present technology requires labor intensive methods to accomplish this.

A simpler, less expensive, parachute is a "cross chute" which includes two rectangular pieces of cloth sewn together in a cross shape. The stitching is simplified in a cross chute inasmuch as the stitching is principally in a straight line and larger pieces of fabric are joined together. Still, the cross chute requires many suspension lines and many reinforcement lines on the canopy.

Both types of parachutes utilize canopies which traditionally are of nylon, which usually is produced in 5 foot wide strips. The nylon pieces must be sewn together and reinforced with lines and tapes.

Considering that most parachutes are used only once in delivery of humanitarian and military supplies, it is deemed necessary that there be made available a much less expensive cargo parachute which offers acceptable performance.

## SUMMARY OF THE INVENTION

Accordingly, an object of the invention is to provide a low cost parachute for cargo airdrops.

1           With the above and other objects in view, a feature of the  
2 invention is the provision of a parachute comprising a plurality  
3 of first strips of fabric adapted to define a pattern wherein the  
4 first strips are separated from each other and extend parallel to  
5 each other, and a plurality of second strips of fabric adapted to  
6 further define the pattern wherein the second strips are separated  
7 from each other and extend parallel to each other and normal to  
8 the first strips, the number of the second strips being equal to  
9 the number of the first strips. The first and second strips cross  
10 each other at center portions thereof and thereby define vent  
11 holes. The ends of the strips are connected to suspension lines  
12 which are extendible to a confluence area.

13           The above and other features of the invention, including  
14 various novel details of construction and combinations of parts,  
15 will now be more particularly described with reference to the  
16 accompanying drawings and pointed out in the claims. It will be  
17 understood that the particular parachutes embodying the invention  
18 are shown by way of illustration only and not as limitations of  
19 the invention. The principles and features of this invention may  
20 be employed in various and numerous embodiments without departing  
21 from the scope of the invention.

1                   BRIEF DESCRIPTION OF THE DRAWINGS

2                 Reference is made to the accompanying drawings in which are  
3                 shown illustrative embodiments of the invention, from which its  
4                 novel features and advantages will be apparent.

5                 In the drawings:

6                 FIG. 1 is a perspective view of one form of parachute  
7                 illustrative of an embodiment of the invention;

8                 FIG. 2 is a top view of a canopy portion of the parachute of  
9                 FIG. 1 disposed in a plane;

10                FIG. 3 is similar to FIG. 2, but showing an alternative  
11                embodiment;

12                FIG. 4 is similar to FIGS. 2 and 3, but illustrative of  
13                another alternative embodiment; and

14                FIG. 5 is similar to FIG. 1, but showing a further  
15                alternative embodiment.

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17                   DESCRIPTION OF THE PREFERRED EMBODIMENTS

18                 Referring to FIG. 1, it will be seen that an illustrative  
19                 parachute includes a canopy 10 and suspension lines 12 fixed at  
20                 one end to the canopy 10 and extendible toward a confluence area  
21                 14.

22                 As shown in FIG. 2, the canopy 10 is formed by a plurality of  
23                 first strips 16 of fabric, preferably woven polypropylene. The  
24                 strips 16 are separated from each other and extend parallel to  
25                 each other. A plurality of second strips 18 of the same fabric

1       are separated from each other and extend parallel to each other  
2       and are normal to the first strips 16.

3           In an embodiment provided to replace a prior art round 26  
4       foot high velocity cargo chute (not shown), the strips 16, 18  
5       preferably are three feet wide and fifty-one feet long. Inasmuch  
6       as woven polypropylene is produced in strips of three feet width,  
7       the stock material does not have to be sewn together to form  
8       larger pieces. The strips are cut to a desired length. The edges  
9       of the strips are finished during the making of the standard  
10      fabric used, and are strong enough to withstand tearing without  
11       the use of reinforcement lines or tapes. The woven polypropylene  
12       material exhibits a tear resistance of 40 to 65 pounds, whereas  
13       commonly used nylon exhibits a tear resistance of 5 to 10 pounds.

14           As best shown in FIG. 2, the strips 16, 18 cross each other  
15       in the center area of the canopy 10. Inasmuch as the strips 16  
16       are separated from each other, and the strips 18 are similarly  
17       separated, the strips 16, 18 form vents 20, which serve to relieve  
18       the canopy of excessive forces which might damage the canopy or  
19       the article of cargo during opening. The arrangement of strips  
20       and the vents formed thereby has been found to provide gentle  
21       opening of the canopy with low opening shock, yet provide  
22       sufficient drag for a desired rate of descent.

23           The strips 16, 18 are sewn together at the areas of their  
24       crossing each other. Aside from this sewing, there is no sewing  
25       in the entire canopy.

1           The suspension lines 12 are ropes, each tied to a strip end  
2         22 by a self-tightening slip knot 24 that extends around the strip  
3         end gathered fabric. One suspension line 12 is tied to each strip  
4         end. Thus, the parachute presented herein in FIGS. 1 and 2  
5         requires twelve suspension lines. The round 26 foot parachute  
6         referred to hereinabove requires 26 suspension lines and the  
7         aforementioned cross parachute generally requires 20 suspension  
8         lines in this size. Chutes larger or smaller require  
9         correspondingly fewer lines than prior art round or cross  
10        parachutes. Inasmuch as the suspension lines 12 are tied to the  
11        strip ends 22, there are no additional attaching loops,  
12        reinforcements, ties or sewing for attachment of the suspension  
13        lines 12 to the canopy 10.

14           Referring to FIG. 3, it will be seen that a smaller version  
15        of the parachute of FIGS. 1 and 2 includes two first strips 16A  
16        and two second strips 18A. In this case, one vent 20A is provided  
17        and only eight suspension lines are required.

18           Thus, the parachute illustrated in FIGS. 1, 2, and 3 enables  
19        the use of stock widths of material without any reinforcement  
20        lines or tapes. The suspension lines are reduced in number and  
21        require no canopy lines or sewing for affixing the suspension  
22        lines. Aside from the area where the strips 16, 18 cross, there  
23        is no required sewing in the canopy of the present parachute.

24           Referring to FIG. 4, there is shown a low velocity version  
25        featuring five first strips 16B and five second strips 18B,

1 providing sixteen vents 20B. In this embodiment, the strips  
2 preferably are 5 feet wide and 90 feet long.

3 The designs described above are scaleable and can be applied  
4 to smaller (FIG. 3) and larger (FIG. 4) parachutes to provide  
5 similar performance at a lower cost. The widths and lengths of  
6 the strips can be proportionally sized to fit larger and smaller  
7 chutes.

8 Tests of the parachute shown in FIGS. 1 and 2 have been  
9 conducted.

10 A parachute attached to a 1,500 pound load was dropped at  
11 5,000 feet. The drop was successful. No damage to the parachute  
12 was experienced and a decent rate of 70 ft/sec. was observed. The  
13 desired range for high velocity cargo drops is 70-90 ft/sec.

14 The same parachute attached to a 2,200 pound load was dropped  
15 at 15,000 feet. The drop was successful. No damage to the  
16 parachute as experienced and the decent rate was clocked at 75  
17 ft/sec.

18 The same parachute attached to a 2,200 pound load was dropped  
19 at 18,000 feet. The drop was successful. No damage to the  
20 parachute as observed. The decent rate was 70 ft/sec.

21 A newly fabricated parachute attached to a 2,200 pound load  
22 was dropped from an altitude of 25,000 feet. The drop was  
23 successful. Minor damage to one strip was noted. The decent rate  
24 was 75 ft./sec.

1           The parachute from the last drop was repaired and attached to  
2        a 2,200 pound load and dropped from 25,000 feet. The drop was  
3        successful.

4           Each drop was from a C-130 aircraft over the Yuma Proving  
5        Grounds. Subsequently, about 20 more successful air drops have  
6        been conducted at max load at 25,000 feet. One drop of the chute  
7        shown in FIG. 4 was conducted with 1,000 lbs. and performed well  
8        at a descent rate of 21 ft/sec.

9           The combined features of the above-described parachute allow  
10       the parachute to be produced for from one third to one half the  
11       cost of the standard round cargo parachute and provides a reduced  
12       impact velocity.

13          Referring to FIG. 5, it will be seen that the confluence area  
14       may include D-rings 15, known in the art, and may include load  
15       spreaders 17. In the latter embodiment, each side of the canopy  
16       10 is provided with a bundle of lines 12 routed through the load  
17       spreaders 17, and thence to the D-rings 15, which support an  
18       article 19 to be delivered. The lines 12 are fastened to the D-  
19       rings 15.

20          The load spreaders 17 are constructed of two pieces of nylon  
21       welding with a loop formed in each end. The load spreaders are  
22       bound together in an X pattern, providing four spaced end loops,  
23       through which pass the lines 12 extending to the D-rings 15. This  
24       arrangement permits the lines to adjust to a tumbling article 19

1 and to the proper opening of the parachute when carrying an  
2 article with uneven loading.

3 There is thus provided a new parachute providing a new  
4 geometry and a new method of construction. The new parachute is  
5 very low in costs, both in terms of materials and cost of  
6 production. The design remains applicable to scaled-up and  
7 scaled-down versions.

8 It will be apparent that when packed or deployed the  
9 parachute will not be laid out in the planar fashion shown in  
10 FIGS. 2-4. However, in the construction of the parachute the  
11 strips are arranged so that they are adapted to define the  
12 patterns shown in FIGS. 2-4.

13 It is to be understood that the present invention is by no  
14 means limited to the particular constructions herein disclosed  
15 and/or shown in the drawings, but also comprises any modification  
16 or equivalent within the scope of the claims.